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CS 4080

Assignment 2

Problem 1: Parse Tree and Leftmost Derivation

Using the grammar below, show a parse tree and a leftmost derivation for the following statement:

A = B * (C * (A + B))

Grammar:

Statement → Assignment | Expression

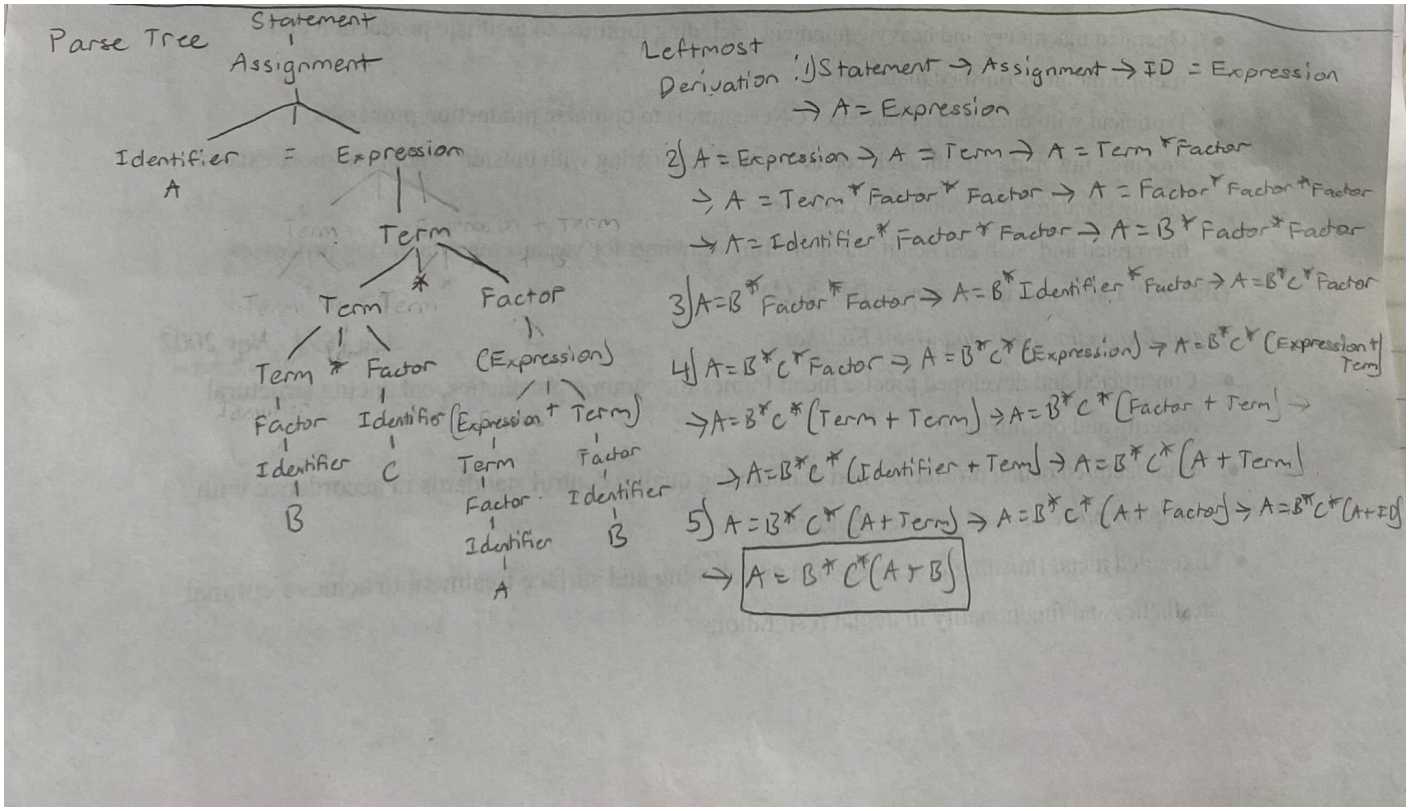
Assignment → Identifier = Expression

Expression → Expression + Term | Term

Term → Term * Factor | Factor

Factor → (Expression) | Identifier

Identifier → A | B | C



Leftmost Derivation (in text):

1) Statement -> Assignment -> Identifier = Expression ->
   A = Expression
2) A = Expression -> A = Term -> A = Term * Factor -> A = Term * Factor * Factor ->
   A = Factor * Factor * Factor -> A = Identifier * Factor * Factor ->
   A = B * Factor * Factor
3) A = B * Factor * Factor -> A = B * Identifier * Factor ->
   A = B * C * Factor
4) A = B * C * Factor -> A = B * C * (Expression) -> A = B * C * (Expression + Term)
   -> A = B * C * (Term + Term) -> A = B * C * (Factor + Term) -> A = B * C *
   (Identifier + Term) ->
   A = B * C * (A + Term)
5) A = B * C * (A + Term) -> A = B * C * (A + Factor) -> A = B * C * (A + Identifier) ->
   A = B * C * (A + B)

Problem 2: Scope Concepts

Considering the following program written in pseudocode:

```
int u = 42;
int v = 69;
int w = 17;

proc add( z:int )
u := v + u + z;

proc bar( fun:proc )
int u := w;
fun(v);
```

```
proc foo( x:int, w:int )
int v := x;
bar(add);

main
foo(u, 13);
print(u);
end;
```

a. Using Static Scope, what is printed to the screen?
Static: not looking down at the stack but takes global values

add(v)	
bar	v = 69, u = 42
foo(u, 13)	v = 69, u = 42, w = 17
main	u, v, w, x

add(v)
u: v + u + v = 69 + 42 + 69 = 180
- In Static Scope, the program would print out '180' since it loses reference to the local variable 'u' after the add/bar functions.
Therefore, the program u = (v + u + v) = (69 + 42 + 69) = **180**

b. Using Dynamic Scope with Deep Binding, what is printed to the screen?
Hint: The sum for u is 126, but due to deep binding, it's foo's local v that gets involved.

Dynamic deep

add(v)	

bar	v = 42, u = 42
foo(u, 13)	v = 42, u = 42, w = 17
main	u = 42 v = 69 w = 17 x = 42

add(v)

- Deep binding would pass add into foo where u = 42, v = 42, and w = 17. Then, the function is passed into bar where v = 42 and u = 42. Therefore, the localized variable v is equal to 42 instead of 69, and u is still equal to 42.

u: v + u + v = 42 + 42 + 42 = **126**

c. Using Dynamic Scope with Shallow Binding, what is printed to the screen?
Hint: The sum for u is 101, but again it's foo's local v that matters.

Dynamic shallow

add(v)	
bar	v = 42, u = 13
foo(u, 13)	v = 42, u = 42, w = 13
main	u = 42 v = 69 w = 17 x = 42

add(v)

- Shallow binding would pass add into foo where u = 42, v = 42, but w = 13 since the method call foo(u, 13) declares 13 as the value for int w. Then, the function is passed into bar where v = 42 and u = 13 instead of 42.
Therefore, the function would be declared as u: v + u + v = 42 + 13 + 42 = **97**